FLIGHT

The AIRCRAFT ENGINEER & AIRSHIPS

First Aero Weekly in the World.

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

OFFICIAL ORGAN OF THE ROYAL AERO CLUB OF THE UNITED KINGDOM

No. 745. (No. 14, Vol. XV.) APRIL 5, 1923 [Weekly, Price 6d. Post free, 7d.

Flight

The Aircraft Engineer and Airships

Editorial Offices: 36, GREAT QUEEN STREET, KINGSWAY, W.C. 2

Telegrams: Truditur, Westcent, London. Telephone: Gerrard 1828

Annual Subscription Rates, Post Free:

United Kingdom .. 30*s.* 4*d.* Abroad .. .. 33*s.* 0*d.**

These rates are subject to any alteration found necessary under abnormal conditions and to increases in postage rates

* *European subscriptions must be remitted in British currency*

CONTENTS

DIARY OF FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in the following list:

Apl. 12	**Lecture, "Some Controversial Points in Aircraft Design," by F. T. Hill, before I.Ae.E.**
May 11	**Lecture, "Experimental Flying," by Maj. M. E. A. Wright, before I.Ae.E.**
June 23	**Grosvenor Challenge Cup, Lympne**
June 25–30	**International Air Congress, London**
June 30	**R.A.F. Aerial Pageant**
July	**Air Race for King's Cup**
July 20	**Gothenburg Exhibition**
Aug. 1	**Entries close from British Competitors for Schneider Cup**
Aug. 3–14	**Rhön Gliding Competition**
Aug. 6	**Aerial Derby**
Aug. 6–27	**French Gliding Competition, near Cherbourg**
Aug. 8–12	**F.I.A. Conference, Gothenburg.**
Sept. 23	**Gordon Bennett Balloon Race, Belgium**
Sept. 28	**Schneider Cup Seaplane Race at Cowes**
Dec. 1	**Entries close for French Aero Engine Competition**
1924	
Mar. 1	**French Aero Engine Competition.**

INDEX FOR VOL. XIV.

The Index for Vol. XIV of FLIGHT (January to December, 1922) is now ready, and can be obtained from the Publishers, 36, Great Queen Street, Kingsway, W.C. 2. Price 1s. per copy (1s. 1d. post free).

EDITORIAL COMMENT.

ACTING with remarkable promptitude—in fact, almost too much so—on the recommendations of the "Hambling Committee," the Air Ministry has announced its readiness to receive proposals from responsible persons for the formation of an air transport company on the lines suggested in the Hambling Report—*i.e.*, the company to be formed with a capital of £1,000,000, and the Government to subscribe as subsidy to the company another £1,000,000, spread over a period of ten years. While we agree that, speaking broadly, the scheme appears to be sound, once it has been admitted, as it now has on all sides, that it is necessary to subsidise civil aviation, there are, as we have previously pointed out, a great number of "if's" to be settled in advance of asking the country to back the scheme with a million.

That Million-Pound Company

Fundamentally, the whole object of this or any other subsidised scheme is, on the one hand, to provide good communications between various parts of the Empire, and, on the other, to keep alive a vigorous aviation industry upon which the country could draw in time of need. Under the term aviation industry we include not only manufacturing and designing concerns, but also the pilots, engineers and ground staff of the air lines themselves, who should be regarded as a strong link in the new Reserve.

If the matter is examined carefully, it is found that, while the formation of such a company would in all probability fulfil the first requirement, *i.e.* provide good communications, it does not follow *ipso facto* that the second would be met. In a previous issue we pointed out as a possible contingency that the company—assuming it to have been formed—might decide to design and build its own machines. In that

case the aircraft industry would not only receive no assistance whatever from the proposed company, but would, on the contrary, be in direct competition with it. That is scarcely a promising way to help either civil or service aviation.

Again, there is the question of the manner in which the company could be useful in case of need. Before anything at all is decided we submit that the demands to be made by the Government should be made known. What restrictions, if any, are to be placed upon the type or types of machines used? We are not among those who believe that any useful purpose can be served by designing commercial machines with a view to their military usefulness. At the moment, it is true, commercial machines might be converted fairly easily into troop carriers, and some of them possibly into long-distance bombers, but this is because, owing to lack of knowledge of what constitutes a commercial machine, we are using machines differing but little from the military machines from which they were developed. The day may be foreseen when the commercial aeroplane will be of no use militarily, except possibly as a troop carrier. But obviously the Government should have some say in the matter of machines, not only as regards types, but also as to how orders are to be distributed. The Hambling Committee refrained from going into these questions, but the Government obviously cannot do so, and there appears to us to be reasons to think that the Air Ministry is going a little too fast. After all, the proposed arrangement is to extend over a period of ten years, and a very great deal depends on the way in which we start. We submit that something considerably more definite should be available before any sort of negotiations are instituted.

Airships as Aircraft Carriers

The experiments which have been made in the United States during the last couple of years or so, and the decision resulting from these experiments of building airships to act as aircraft carriers, should give us something to think about on this side. Let it be remembered that we in this country were the first to suspend aeroplanes from the keel of a rigid airship and drop them while in the air. Came the time when we fancied we could not afford airships, and experiments, not only along this line but on many others, were discontinued.

The Navy washed its hands of airships—only to wake up to the fact that it wanted them after all and wanted them badly. Was this change of opinion prompted by the success of the Americans in using them as aeroplane carriers, we wonder? The Air Ministry itself is not entirely without blame either in the matter. The official excuse, which is always being put up in defence of the abandoning of airships, is that the Air Ministry had no money, or, rather, that what little it had it preferred to spend on heavier-than-air craft. That decision may well be regretted now, especially when it is recalled that the pro-Navyites have now been reduced—for all practical purposes—to the plea that the one thing aircraft lacks is range, which is what the Navy is prepared to give it by manning and equipping the aircraft carriers. There seems to be good reason to suppose that the airship may usefully step in and give aeroplanes and seaplanes the necessary range by carrying them the greater part of the way to the objective, then dropping them to do their work of bombing and/or torpedoing. Thus, had the Air Ministry decided to retain airships, it might have been in a position today of replying to the pro-Navyites that aircraft does have long range, when carried on an airship. The fact that America has a monopoly on helium makes her position even stronger, and although a war between Great Britain and the United States in unthinkable, it is not without interest to realise that by using airships as carriers America has brought, or is about to bring, Europe within flying distance of New York.

Going—GOING

We have referred on several occasions to the way in which sporting aviation is encouraged abroad by official support in the form of orders and even direct participation in sporting events. The Pulitzer Race in America is a case in point. Both the American Navy and Army ordered machines for this event, and military and naval pilots took part in the actual race, which was won by one of them. Shortly after the race General Mitchell established a world's speed record on one of the Pulitzer machines. In France encouragement has always been given to service aviators, who are not debarred from taking part in flying events, and for whom special prizes and competitions are established. Sadi Lecointe beat General Mitchell's record in February, but is now claimed to have been beaten by Lieut. Maitland, whose speed is stated to have exceeded that of Lecointe by ten miles per hour.

On March 30 two French military pilots established records for speed over 500 and 1,000 kilometres. The next day both records were broken by two American military pilots.

The moral we wish to point is that all this has been possible by direct Government encouragement. In this country the authorities look askance at R.A.F. pilots taking part in civilian races, and as for letting R.A.F. machines take part, that is looked upon as something too horrible to contemplate. Why? The fact that America is gradually collecting all the world's records cannot but react favourably on American aircraft and the American aircraft industry, in the matter of prestige (and profit) no less than by the direct benefit of the experience which the design, construction and flying of these machines gives the constructing firms. When are we going to follow this excellent example?

NEW AIR TRANSPORT COMPANY

Proposals Invited by Air Ministry

THE Air Ministry announce that they are prepared to receive proposals from responsible persons for the formation of an Air Transport Company on the lines indicated by the Secretary of State for Air in the House of Commons on March 14, arising out of the recommendations of the Civil Air Transport Subsidies (Hambling) Committee.

As the proposed company may have to start operations on April 1, 1924, it is desirable that it should come into existence at an early date. The Air Ministry, without imposing a specific time limit for offers, desire to announce that they hold themselves at liberty to close with any offer which they regard as satisfactory by July 1; and in order that offers may receive full consideration it will be advisable that outline proposals should be made by May 1.

Proposals should be addressed to the Secretary, Air Ministry, Adastral House, Kingsway, W.C. 2.

THE 220 H.P. LAWRANCE J1 AIR-COOLED AERO ENGINE

We give below some particulars and illustrations of the Lawrance 9-cyl. radial air-cooled engine, which was fitted to the Curtiss TR1 seaplane that won the Curtiss Marine Trophy Race at Detroit last October.

C. T. Lawrance, president and chief engineer of the Lawrance Aero Engine Corp., of New York, is the designer of this engine, the J1, which is now being produced on orders from the U.S. Army and Navy. It was originally designed as a 200 h.p. engine especially for the problem of ship-board combat aeroplanes where minimum weight and greatest simplicity are essentials. It has since been developed to a 276 h.p. engine at 1,970 r.p.m. The principal characteristics of the J1 are: Bore, $4\frac{1}{2}$ ins.; stroke, $5\frac{1}{2}$ ins.; swept volume, 874·5 cu. ins.; compression, 5–1; rated h.p., 200 at 1,700 r.p.m.; fuel consumption, ·5 lb. per h.p./hr.; oil consumption, ·03 lb. per h.p./hr.

Each cylinder is an aluminium casting integral with the head, valve ports and cooling fins, with a case-hardened steel liner $\frac{1}{16}$ in. thick, shrunk into place. The valves are placed at an angle of 8° with the centre line, and rest on bronze seats cast in the cylinder. There is one inlet and one exhaust valve per cylinder, all being 2 ins. diameter and the exhaust valves are mercury cooled; valve lift is $\frac{7}{16}$ in. The valve guides are of bronze, and double springs are employed for each valve, which are operated by rockers and push-rods extending from the cam disc located in the front portion of the crank-case. Each cylinder is held in place on the crank-case by eight $\frac{3}{8}$ in. studs. Two spark plugs are provided for each cylinder.

The aluminium crank-case is in three portions. The front cover contains the magneto drive gearing, the deep groove Hess Bright radial type thrust bearing, and has two magneto supporting brackets located on each side of the crankshaft. This location of the magnetos insures their accessability with the removal of the minimum amount of cowling, thus guaranteeing their proper inspection and maintenance.

Between the front cover and the main body of the crank-case is located the intermediate cover containing the cam driving gears and counter-shaft, the cam disc, the cam followers and their guides, and having a solid web at its rear portion, supporting an S.K.F. self-aligning ball-bearing which forms the front main bearing of the crankshaft.

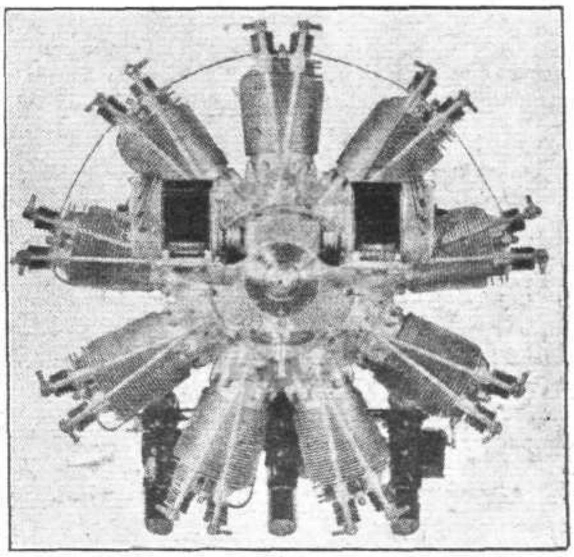
This construction of the front and intermediate covers allows the inspection of all the cam-operating mechanism in place with all gears meshed, by merely removing the front cover, thus avoiding the need of any "blind" operations in assembly.

The main portion of the crank-case consists of a circular drum, with nine openings through which project the nine cylinder liners, an opening for the oil sump between cylinders five and six and a rear wall in which is located an S.K.F. self-aligning ball-bearing which forms the rear crankshaft bearing.

At the rear of this wall is a conical extension of the same approximate diameter of the main portion of the case, which is used for mounting the engine to the front bulkhead of the fuselage.

The crankshaft is a one-piece forging of chrome nickel steel, heat treated. It is hollow for oil circulation, and is provided with 29 small integral splines near its forward end for mounting the propeller hub. The 30th spline is left blank to insure always putting the hub on in the same position.

On the crank cheeks are assembled two bronze balance weights which completely neutralise all reciprocating and



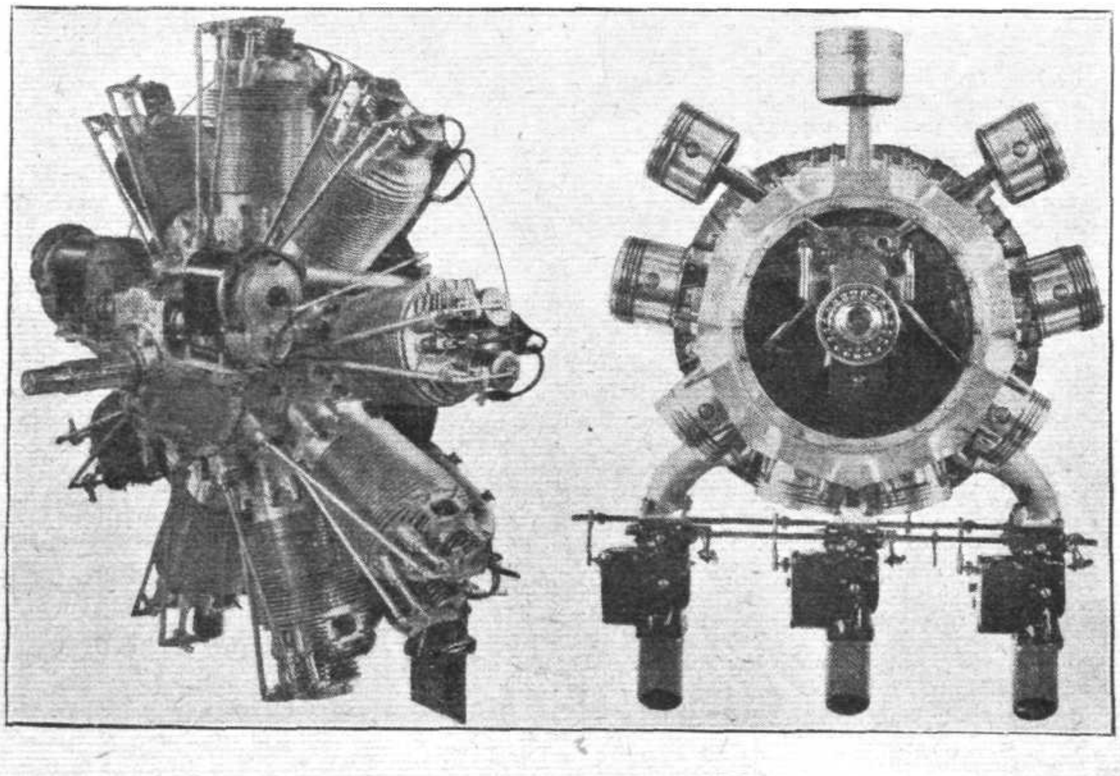
THE 220 H.P. LAWRANCE J1 AIR-COOLED AERO ENGINE: Front view.

centrifugal forces and insure a remarkable absence from vibration.

The shaft is mounted on three ball-bearings mentioned above and plain bearings at the front and rear ends through which a flow of oil is introduced into the crankshaft.

The crank pin is a plain bearing of large area on which runs the babbited big end bearing of the master connecting rod.

The master connecting rod is an I-section forged from chrome nickel steel having a big end provided with flanges at each side, which forms the supports for the knuckle pins of the eight other articulated connecting rods. The big end is split, as in the conventional type of connecting rod, and is held together by four heat-treated alloy steel cap screws.



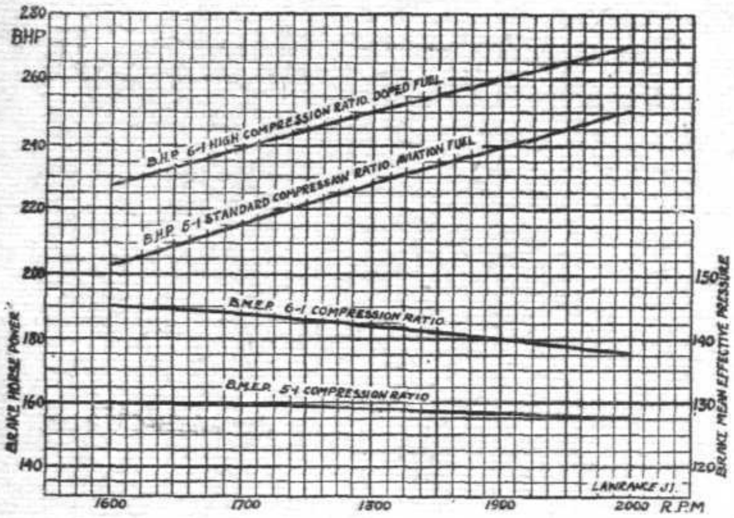
The 220 h.p. Lawrance J1 Air-cooled Aero Engine: Two views of the 10-cyl. radial engine, showing on the left a three-quarter front view of the complete engine, and on the right the cylinders removed exposing the connecting rods and pistons.

By reason of the heavy flanges at each side of the big end, this bearing is exceptionally rigid, and in service shows a very long life.

The articulated rods are of round hollow section of chrome nickel steel, bronze bushed at both ends. The knuckle pins which attach these to the master rod are fixed in the latter by clamping plates, one for each two pins, which not only hold them in place but prevent any rotation.

By means of this system, all the knuckle pins can be removed through the opening formed by removing the front and intermediate covers, by merely removing the four locking plates and withdrawing the knuckle pins with a special form of puller which is provided. This can be done without removing the engine from the plane.

The wrist pins float in both the pistons and connecting rods, and are held in place by small aluminium buttons, pressed into the ends of the hollow pin. The pistons are of conventional design and made of aluminium alloy with a heavy flat head, and are provided with four rings above the pin and one in the skirt. The skirt ring, and the lowest upper ring are bevelled for half their surface, the bevel being toward the top, and act as wiper rings to prevent excess oil getting into the cylinders.



THE 220 H.P. LAWRANCE J1 AIR-COOLED AERO ENGINE : Power-curve chart.

The lubricating system consists of two oil pumps, one of which draws oil from the tank and delivers it to the crankshaft, and another, which draws oil from the sump and returns it to the tank.

These pumps are at the rear of the engine, and are driven by spur gears from the lower end of the synchroniser drive shafts.

Incorporated in the casing of each pump is a chamber containing a strainer which can be removed separately or as a unit with the pumps. On the pressure pump is an oil by-pass valve controlled by a heavy spring, which is intended as a safety valve in case of too sudden warming up of the engine in cold weather, when the pressure might rise to a point where damage might occur.

The oil flows from this pump through a fine mesh screen to a bearing on the rear of the crankshaft which is provided with spiral grooves at this point, so as to prevent oil leakage. It flows from here into the shaft, and also is led by small ducts to the top of the synchroniser drive ball-bearings, the fuel pump and electric generator and tachometer drive gears. The oil in the crankshaft travels through an ample passage to two holes located in the crank pin, where it is fed to the bearing by a pressure of approximately 50 lbs.

Through small holes in the bearings it is led to the interior of the knuckle pins and thence to the knuckle pin bearings. The oil escaping from these bearings and from the sides of the main connecting rod bearing is thrown into the cylinders and lubricates the wrist pins, pistons and cylinders.

The remainder of the oil in the shaft travels to the front end of the engine, where a small quantity escapes through a special jet, which projects into the inside of the shaft to prevent its possible obstruction by sediment.

This oil sprays on the interior of the cam bearing, and also lubricates the cam followers and rollers and the cam drive and magneto drive mechanism.

The remainder of the oil flows to the front end of the engine, where it escapes into an oil collector bearing. An adjustable oil pressure valve is located at this point maintaining any desired oil pressure in the system. The excess oil is then led back to the tank.

The oil which is thrown off from the moving parts flows by gravity into a sump, from which it is drawn through a strainer to the oil return pump and thence to the tank.

The inlet system consists of three NAS4 Stromberg carburetors and three separate ring-shaped manifolds, each one of which acts as an independent intake system for three cylinders at 120° from each other.

The carburettors are equipped with altitude control, consisting of an auxiliary air inlet controlled by a throttle admitting air to a point between the Venturi and the main throttle.

The flow of air through this passage also by means of a small communicating hole sets up a slight depression in the float chamber thus diminishing the flow of fuel at the jet. The float chambers are located at the side of the jet so that steep angles of climb and descent have no effect on the level of the fuel in the jet.

The intake tubes leading from the crankcase to the cylinders are joined by rubber hose connections, thus allowing for expansion and contraction and for slight errors in alignment.

The ignition system consists of two Splitdorf SS9 magnetos having variable advance both running anti-clockwise at one and one-eighth engine speed.

The rated power of the engine is 200 h.p. at 1,700 r.p.m., but actually one engine developed considerably more than this. The accompanying horse-power curve shows a horse-power of about 215 at 1,700 r.p.m. which is the average performance of the engines now being produced. It will be seen that this power runs to 245 h.p. at 2,000 r.p.m., and that the m.e.p. nowhere falls below 128 lb. per sq. in. The fuel consumption at full throttle is less than 0·05 lb. per h.p. hour when adjusted for maximum horse-power. When adjusted for minimum consumption, a figure as low as 0·46 lb. per h.p. hour can be obtained. The oil consumption is 0·03 lb. per h.p. hour.

The same engine when fitted with 6 to 1 high-compression pistons and using a fuel consisting of half benzole and half aviation spirit, develops nearly 240 h.p. at 1,700 r.p.m. and 270 h.p. at 2,000 r.p.m.

NOTICES TO AIRMEN

Franco-Belgian Aerial Corridor

1. AN additional aerial corridor between France and Belgium, for the passage of machines flying on the London-Brussels northern route, has been established. This is a coastal corridor, 5 kilometres in width, commencing from the North Sea.

2. *Previous Notices.*—Para. 2 of Notice to Airmen No. 5 of 1923 is amplified by this notice.

(No. 21 of 1923.)

Paris-Brussels : Official Route

1. THE following route between Paris and Brussels has been defined by the French and Belgian authorities :—

Between Le Bourget and St. Quentin.—The main road (*route nationale*) *via* Senlis, Verberie, Compiègne, Noyon and Ham.

St. Quentin and the Belgian frontier.—The main road from St. Quentin to Cambrai as far as a point 3 kms. N. of Bellenglise. From this point, the secondary road which runs in a straight line through Nauroy, Estrees, Maretz, west of Le Cateau, the western edge of the forest of Mormal, Bavai, Hon, La Ruelle and Curgies.

The Belgian frontier and Mons.—The continuation of the above road through Sars-la-Bruyère, Eugies, Frameries and Cuesmes.

Mons and Hal.—The road through Nimy, Soignies and Tubize.

Hal and Brussels.—The Wilbroeck canal to the neighbourhood of Haren aerodrome.

2. *Rules of the Air.*—The rules to be observed in following an officially recognised route are laid down in Notice to Airmen (No. 64 of 1922.)

(No. 23 of 1923.)

A DISCUSSION OF GERMAN AND ENGLISH METHODS OF COMPUTING AEROPLANE PERFORMANCE

By F. RADCLIFFE, B.Sc. (Vic.)

[Owing to the lack of uniformity in presenting the results of wind-tunnel experiments and other aerodynamic work, the student of aeronautics frequently finds himself baffled if and when he attempts to make a first-hand study of what has been accomplished abroad. In France Eiffel introduced the system of plotting wing characteristics as a "polar" diagram, using the lift coefficient as ordinate and the drag coefficient as abscissa. Furthermore, the Eiffel coefficients have to be multiplied by 8 to make them equal to the "absolute" coefficients used in this country and—until recently—in the United States.

In Germany the polar diagram is also used, based upon those first employed by Lilienthal. Here, however, the "absolute" coefficient system has been adopted, but the coefficients have double the value of our absolute coefficients—due, as Mr. Radcliffe points out, to the fact that the Germans use $\frac{1}{2}\,.\,\rho/g$, while in this country we use ρ/g. Thus from the very outset the student is faced with a variety of "snags." Add to this the fact that he is reading the explanatory text in a language with which he is probably not familiar, and in which different symbols are used to denote the same thing (for instance, k_y is used by Eiffel to denote the lift coefficient, while in this country it is now usual to denote this coefficient by k_L, and in Germany by c_a), and it will be seen that even in the most elementary things difficulties arise. When we come to the more complicated expressions the situation becomes even worse. We have therefore felt that the paper read by Mr. Radcliffe before the Students' section of the Royal Aeronautical Society some time ago deserves to be more widely known, and have decided to publish it in Flight, in the hope that the paper will assist many who are now groping for an explanation of the often puzzling presentation of aerodynamic calculations in German aviation papers and text-books.—Ed.]

Introduction

The nineteenth century has been well termed the Age of Nationalism; and historians tells us that the present century marks a new epoch—that of Internationalism. It is with the latter thought in my mind that I wish to emphasise the need for more concerted action in the realms of science. The recent advances made in our own particular branch of science—that of aeronautics—have been great; but, through very natural reasons, there has been a marked tendency for those advances to proceed along different paths, or, shall I say, by the utilisation of different forms of mechanism. This is seen very noticeably to be the case in the methods employed by the Germans and those employed by ourselves in the estimation of an aeroplane's performance.

My object in writing these few notes is to set before you the outstanding points in the German method, showing you its good points and then its bad points, and comparing it with our own method. The time at my disposal is too short for me to outline the English method at any length, and all I can do is to put before you an actual example worked out according to the English method, and then afterwards to show you the same data utilised in the modified German method. From the outset let me say that the German methods I have been able to come across have all ignored "slip-stream" effect, and it is the taking into account of these effects that has caused me to speak of a "modified" German method. My chief aim will be to stimulate a wider, and shall I say an international, interest in aeronautics, which will lead us to study other people's views and mode of dealing with our everyday problems.

I should like to express my very grateful thanks to the Blackburn Aeroplane Co., and in particular to the chief designer, Maj. F. A. Bumpus, for permission to use the "Swift F" torpedoplane, as manufactured by them, as the basis for my examples.

The Representation of the Characteristics of an Aerofoil

In estimating the performance of an aeroplane by any method, the first requirement is a knowledge of the lift and drag of the aerofoil section we have chosen for the wings of our machine. The German method differs from ours. We are in the habit of plotting the lift (k_y) and the drag (k_x) of an aerofoil as two separate curves with the angle of incidence as abscissa. In addition to these we plot L/D (*i.e.*, k_y/k_x) against the corresponding angles of incidence. Thus, we have three curves which give the characteristics of a section. In the German method k_y is plotted directly against k_x as abscissa, giving us what is usually termed the "polar" diagram.

Whilst we are speaking about the characteristics of an aerofoil, it ought to be mentioned that the German coefficients are relatively double the value of ours, the general form of their equation being given by—

$$\text{F.} = \text{K}'.\frac{\rho}{2g}.\text{A.V}^2 \qquad (1)$$

whereas ours is given by—

$$\text{F.} = \text{K}'.\frac{\rho}{g}.\text{A.V}^2 \qquad (2)$$

If we use the "F.P.S." system of units in both equations, (1) and (2), we see that K. = 2K′.

Let us digress for a moment or two and consider these two systems of absolute units, and put as general equations :—

$$p = \text{K}\frac{\rho}{2g}\text{V}^2 - \text{German} \qquad (3)$$

$$p = \text{K}'\frac{\rho}{g}\text{V}^2 - \text{English} \qquad (4)$$

where $p = \frac{\text{F}}{\text{A}}$, *i.e.*, the intensity of pressure per square foot (using the F.P.S. system of units). If we were to take a pitot tube for finding the pressure difference between air at rest and air with a velocity of V feet per second, we know that by means of Bernoulli's theorem we have :—

$$\text{The pressure difference} = p_1 - p_0 = \tfrac{1}{2}.\frac{\rho}{g}.\text{V}^2 \text{lbs. per sq. ft.} \qquad (5)$$

where p_1 = pressure of the air at a velocity of V ft. per sec. and p_0 = pressure of the air at rest.

Hence, we see that the German expression is directly connected with the dynamical pressure of the air, whereas our expression of ($\rho/g.\text{V}^2$) can only be interpreted as "twice the dynamical pressure." Furthermore, we see that the German choice is a *natural* choice of an expression, whereas ours is an *artificial* choice. This latter choice, however, is so universally used in this country that I shall not use the German expression even when working out a performance calculation after the German manner, as I do not think it would lead to greater lucidity. With these few remarks let us return to the representation of aerofoil characteristics.

Now the term "angle of attack of an aerofoil" is merely a conventional term for the angle between the chord of the aerofoil and the direction of the air's velocity. Aerodynamically, it has no definite significance, for it depends on our definition of the chord of an aerofoil. The definition of the chord of an aerofoil is not clear in some cases, and in others breaks down completely. Consider a wing with *wash-in* and *wash-out* (*i.e.*, a twisted aerofoil), or a system of planes where the chords are not parallel. Here the term "angle of attack" fails entirely. Thus, we see that in plotting the various coefficients against angles of attack we have no natural basis for comparing different systems of aerofoils. What we generally like is to have the ratio of $\frac{k_y}{k_x}$ as large as possible, and the angle of attack interests us merely as a structural consideration. With the English system of two curves for *ky* and *kx*, there is not the same vividness as with the polar diagram.

Recent researches* have shown that the lift of an aerofoil depends not on the angle of attack, but on the "circulation" of the air round the section. That is to say, the air flow round wings of the same section but of different plan form is the same for equal values of *ky*, and not necessarily for equal values of the angle of attack.

Again, it has been found convenient to divide the drag of an aerofoil into two parts—one, due only to the plan form of the aerofoil and termed the "induced" drag, and, secondly, that due to the type of aerofoil section used, which has been

* *E.g.*, the work by Prandtl, Glauert, etc.; *vide* "The Theoretical Relationship for the Lift and Drag of an Aerofoil Structure," by H. Glauert, M.A., read before R.Ae.S. on November 30, 1922.

termed the "section" drag. The "induced" drag can be found from the general formula :—

$$D = \frac{1}{\pi} \cdot \frac{L^2}{V^2 \cdot \frac{\rho}{g} \cdot B^2} \qquad (6)$$

where L = lift in lbs.
B = span in feet.

$V^2 \cdot \frac{\rho}{g}$ = "twice the dynamical pressure."

And as $D = k_x \cdot \frac{\rho}{g} \cdot A.V^2$

we get $k_x = \frac{1}{\pi} \cdot k_y^2 \cdot \frac{A}{B^2}$ (7)

This applies to a single aerofoil. For a system of aerofoils we replace B by KB where K is less than unity. The form of equation (7) reminds us that it will be a parabola. It cannot be plotted against angles of attack until tests have been done because there is no definite relation between lift and the angle of attack of an aerofoil.

"Section" drag is dependent on the section of the aerofoil, and must be obtained from tests either on models or in free flight. This part of the drag is determined, for example, by the change in the performance of an aeroplane when only the total load is changed.

Body Resistance

Continuing our investigation a little further, we remember that the resistance of those parts of a machine other than the wings is closely proportional to the square of the velocity.

i.e., $R = KV^2$ (8*a*)
where R is the resistance in lbs.
K is a constant
and V is in feet per second.

(For the time being we shall ignore the effect of slip-stream on body resistance, and consider it later.) We can now write equation (8*a*) in terms of the constants used in equation (3), giving us :—

$$R = k_{r1} \cdot \frac{\rho}{g} \cdot A.V^2 \qquad (8b)$$

where k_{r1} is the new constant to be used later.

Available Thrust

It has been shown* that the falling off of thrust from a propeller, considered at any altitude, can be represented very approximately by

$$T = \frac{\rho'}{\rho}\left(T_s - K'V^2\right) \qquad (9)$$

where T = thrust in lbs.
T_s = static thrust in lbs.
ρ and ρ' = density of the air at sea-level and at the altitude in question,
and K' = constant.

It is at once apparent from this equation (9) that we can conceive this falling off of thrust due to the machine's forward speed as being of the nature of a fictitious body resistance following the very same law as for body resistance. Equation (9) can thus be recast into

$$T = \frac{\rho'}{\rho}\left(T_s - k_{r3} \cdot \frac{\rho}{g} \cdot A.V^2\right) \qquad (10a)$$

or, the fictitious body resistance

$$= R_f = \frac{\rho'}{\rho}\left(k_{r3} \cdot \frac{\rho}{g} \cdot A.V^2\right) \qquad (10b)$$

where R_f is in lbs.
K_{r3} is an absolute coefficient and constant.

This is, of course, assuming that the available thrust varies directly with the density of the air.

Slip-Stream Effect

It is only of very recent years that the slip-stream effect on body resistance has been consistently taken into account, and we are now faced with the problem of how to incorporate slip-stream effect with body resistance. On turning up the references at my disposal I found that none of the German methods took it into account, so I looked into the problem myself. If v_x is the outflow velocity from a propeller in feet per second, then we know that all portions of the machine lying within a circle of diameter equal to 0.9 of the propeller diameter offer a resistance which is closely proportional to $(V + v_x)^2$, or,

$$R = \frac{\rho'}{\rho} K (V + v_x)^2 \qquad (11)$$

If we refer to p. 112 of H. C. Watts's book, "Screw Propellers for Aircraft,"† we shall find a chart on which is plotted $\left(\frac{T}{A_e}\right)$ against the machine's speed in miles per hour, where

A_e = the "effective disc area" through which air can be considered to flow (in square feet)
and T = the thrust in lbs.

Then, from other diagrams in the same book, or from the curves to be found in our Chairman's book,‡ we are in a position to get out a table connecting available horse-power with the forward speed of the machine. From these particulars we can then find the values of $(V + v_x)$ corresponding to V, and, incidentally, we can get out a curve showing the diminution of thrust with the forward speed. These are all shown in Fig. 1.

Let us now turn to our consideration of bodies in the slip-stream. We saw in equation (11) that their resistance was proportional to $(V + v_x)^2$. Hence, by using the curves in Fig. 1 we can convert our slip-stream resistance coefficient into a variable one depending on the forward speed of the machine, and, at the same time, we can introduce the constant quantities ρ/g and A, giving us an equation similar to (8*b*) or (10*b*) :—

$$R_{ss} = \frac{\rho'}{\rho}\left(k_{r2} \cdot \frac{\rho}{g} \cdot A.V^2\right) \qquad (12)$$

where k_{r2} is a variable coefficient whose values are ascertainable ; and R_{ss} is the resistance in pounds of the parts of the machine lying inside the slip-stream.

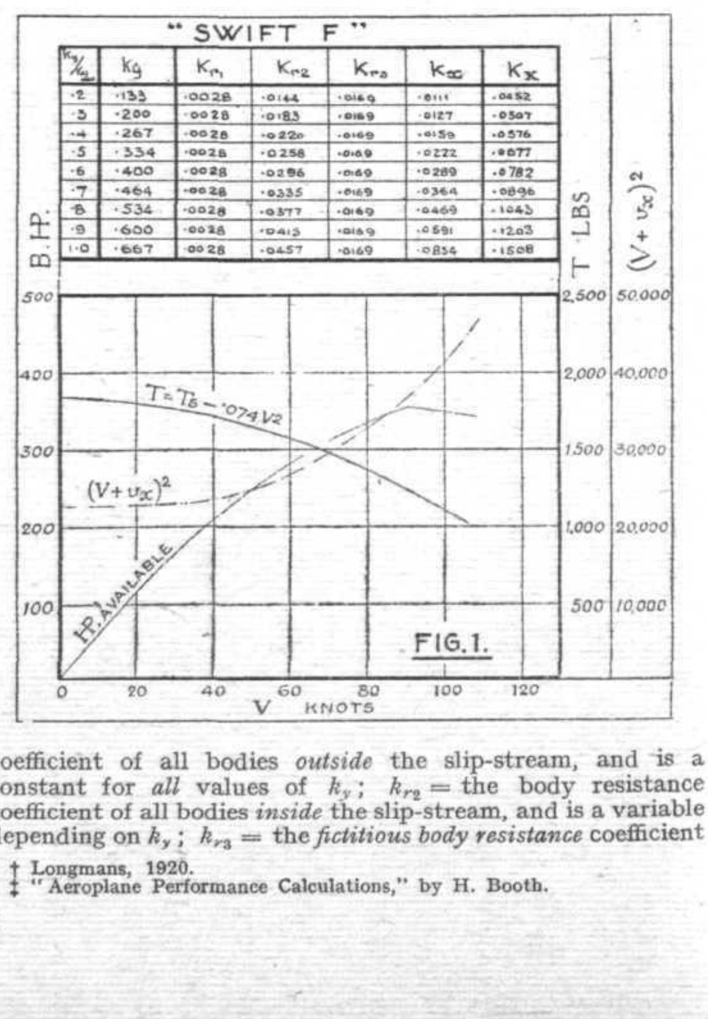
Total Resistance of the Machine

Gathering our components together, we get the total resistance of the machine given by :—

$$R = \frac{\rho'}{\rho}\left(k_x + k_{r1} + k_{r2} + k_{r3}\right) \cdot \frac{\rho}{g} \cdot A.V^2 \qquad (13)$$

$$\text{or} \quad R = \frac{\rho'}{\rho}\left(k_X \cdot \frac{\rho}{g} \cdot A.V^2\right) \qquad (14)$$

Where R = resistance in pounds, k_x = the drag coefficient of the wings, and varying with k_y ; k_{r1} = the body resistance coefficient of all bodies *outside* the slip-stream, and is a constant for *all* values of k_y ; k_{r2} = the body resistance coefficient of all bodies *inside* the slip-stream, and is a variable depending on k_y ; k_{r3} = the *fictitious body resistance* coefficient



K_y/K_y	K_y	K_{r1}	K_{r2}	K_{r3}	$K_{x\infty}$	K_X
·2	·133	·0028	·0144	·0169	·0111	·0452
·3	·200	·0028	·0183	·0169	·0127	·0507
·4	·267	·0028	·0220	·0169	·0159	·0576
·5	·334	·0028	·0258	·0169	·0222	·0677
·6	·400	·0028	·0296	·0169	·0289	·0782
·7	·464	·0028	·0335	·0169	·0364	·0896
·8	·534	·0028	·0377	·0169	·0469	·1043
·9	·600	·0028	·0415	·0169	·0591	·1203
1·0	·667	·0028	·0457	·0169	·0854	·1508

FIG. 1.

* Vide (1) "Technische Berichte," Vol. I, Part I (1), March 15, 1917 ; and (2) Report 97, U.S.A. (N.A.C.A.), Part IV, "Equation" (66) ("General Theory of the Steady Motion of an Airplane," by George de Bothezat).

† Longmans, 1920.
‡ "Aeroplane Performance Calculations," by H. Booth.

of the power unit, and is a constant for *all* values of k_y; and k_X = the sum of all the above four coefficients.

The values of k_y are tabulated along with the corresponding values of the components of k_X in the case of the "Swift F" torpedoplane in Fig. 1. Fig. 2 shows the side view of the "Swift F," as supplied to the U.S.A. Government. Fig. 3 shows k_y plotted against k_X, giving us the polar diagram for the machine.

Interpretation of the Polar Curve

First, let us look at the tabulation and results obtained from our data, as given by the English method indicated in the previously mentioned book of our Chairman. These are shown in Tables I and II and on Fig. 4. With these tables and diagrams in our minds, let us now interpret the polar curve and see if we cannot obtain the same information.

Any straight line drawn from the origin to cut the polar curve does so at a point which represents a certain value for $\frac{k_X}{k_y}$. For horizontal flight at sea-level the thrust available must balance the resistance of the machine. That is to say :—

$$T_s = k_X \cdot \frac{\rho}{g} \cdot A.V^2 \qquad (15)$$

and the lift of the wings must be equal to the weight of the machine (very approximately). In other words, if the weight of the machine = W lbs.

$$\text{then } W = k_y \cdot \frac{\rho}{g} \cdot A.V^2 \qquad (16)$$

Hence $\frac{T_s}{W} = \frac{k_X}{k_y}$, and as $\frac{T_s}{W}$ represents the machine's flying conditions at sea-level, we are in a position to find the maximum speed of the machine at sea-level. We know T_s and W, and if we draw a line from the origin given by $\frac{k_X}{k_y} = \frac{T_s}{W}$ we shall be able to find at what values of k_y and k_X it cuts the polar. Taking this value of k_X and putting it in equation (15) will give us the necessary information for finding V_{max}.

$$i.e., V_{max} = \sqrt{\frac{T_s}{\rho/g \cdot A \cdot k_X}} \qquad (17)$$

where V_{max} is in feet per second.

In order to obtain the maximum flight speeds at altitudes we replace $\frac{T_s}{W}$ by $\frac{\rho'}{\rho}\frac{T_s}{W}$ where $\frac{\rho'}{\rho}$ denotes the relative density of the air at the altitude in question. If we desired we could construct a velocity scale at the foot of our polar diagram by substituting in (17) different values for k_X.

To get the absolute ceiling we can make use of Everling's formula for the variation of the density of the air with altitude.

$$0{\cdot}0000141\ H = \log_{10} \frac{\rho}{\rho'} \qquad (18)$$

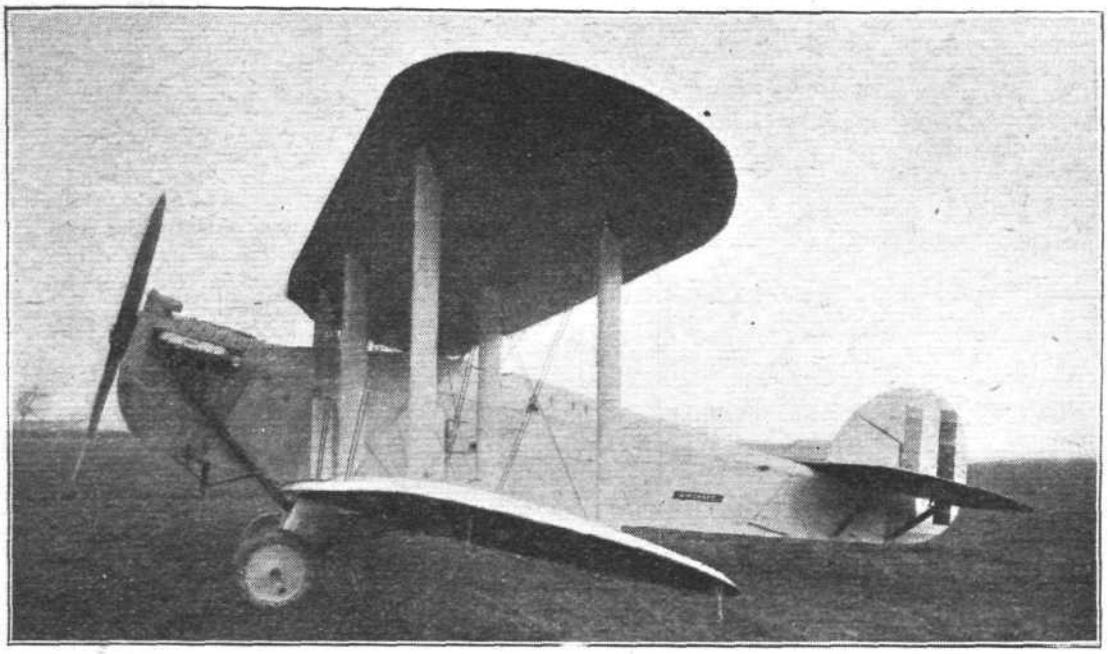
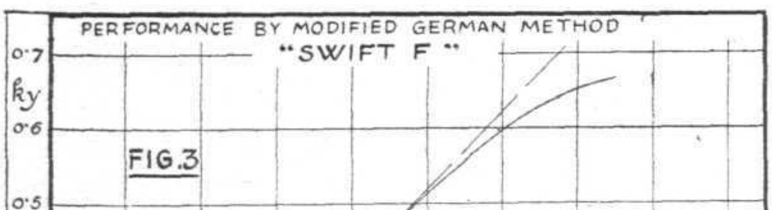
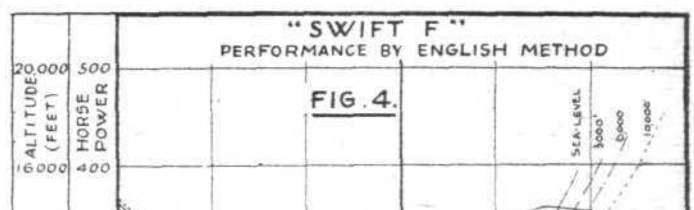


Fig. 2.—The Blackburn "Swift" Torpedoplane.





where H is the altitude in feet
ρ is the density of air at sea level,
and ρ' is the density of air at the altitude required.

$$\text{If we call } \frac{T_s}{W} = \theta \text{ and } \left(\frac{\rho'}{\rho}.\frac{T_s}{W}\right) = \theta' \qquad (19)$$

$$\text{Then } \frac{\theta}{\theta'} = \frac{\rho}{\rho'} \qquad (20)$$

As H in equation (18) is a maximum when θ' is as small as possible, since θ is a constant for any one machine, then θ_{min} is given by the tangent to the polar curve from the origin. The absolute ceiling is then obtainable from equations (20) and (18).

Everling also finds that for a climb with the angle of attack constant the maximum rate of climb is closely proportional to the height below the absolute ceiling (H_{max}) for any altitude H feet.

$$\text{Or, } \frac{dH}{dt} = C\left(H_{max} - H\right) \qquad (21)$$

which is a linear curve.

Integrating, we get :—

$$t = \frac{1}{K}\log_{10}\left(\frac{H_{max}}{H_{max}-H}\right) \qquad (22)$$

which, incidentally, is the curve traced by the barograph. Putting in the value of the constant in equation (21), we have—

$$\frac{dH}{dt} = V \text{ feet per } min. = 0 \cdot 00323.\theta_{min}.V_c\left(H_{max} - H\right) \qquad (23)$$

where V_c = the maximum flight speed at the ceiling in feet per second.

It follows from the above that for different aerofoil sections giving the same values of θ_{min} the rate of climb increases with V_c. In other words, the rate of climb will be greatest for that section which has the lowest values of k_y and k_X. This is useful in comparing aerofoil sections for use on a proposed machine.

The time taken to climb to any altitude H feet is given by

$$t_{secs.} = \frac{1}{0 \cdot 0001519 . \theta_{min}.V_c}.\log_{10}\left(\frac{H_{max}}{H_{max} - H}\right) \qquad (24)$$

The maximum load a machine can carry (W_{max}) is given by the tangent to the polar curve, since this may be taken as equal to $\left(\frac{T_s}{W_{max}}\right)$. Thus, if W is carried by conditions as represented by the line θ, the maximum load capable of being carried at the same altitude is given by

$$\frac{W_{max}}{W} = \frac{\theta}{\theta_{min}} \qquad (25)$$

Swift "F" Performance Calculations. (Modified German Method.)

1°. Body resistance outside slip-stream.
R_1 = 48 lbs. at 100 ft./sec.

$$i.e., \ 48 = k_{r_1}.\frac{\rho}{g}.A.V^2 \text{ where } V = 100 \text{ in this case}$$

$$\therefore \ k_{r_1} = \frac{48}{0 \cdot 00237 . 720 . 100^2} = \underline{\underline{0 \cdot 0028.}}$$

2°. Body resistance inside slip-stream.
R_2 = 169 lbs. at 100 ft./sec.

$$\therefore \ 169 = k_{r_2}.\frac{\rho}{g}.A.\left(\frac{V + v_x}{V}\right)^2.V^2 \text{ when } (V + v_x) = 100$$

$$\therefore \ k_{r_2} = \frac{169}{0 \cdot 00237 . 720 . 100^2} = \underline{\underline{0 \cdot 0099.}}$$

In this case k_{r_2} is a variable dependent upon V and the values for $\left(\frac{V + v_x}{V}\right)^2$ are obtained from the curve as shown in Fig. 1.

$\frac{k_y}{ky_{max}}$	$\left(\frac{V + v_x}{V}\right)^2$	k_{r_2}
0·2	1·46	0·0144
0·3	1·85	0·0183
0·4	2·22	0·0220
0·5	2·61	0·0258
0·6	2·99	0·0296
0·7	3·39	0·0335
0·8	3·81	0·0377
0·9	4·20	0·0415
1·0	4·62	0·0457

3°. Thrust diminution is given by :—

$$T = T_s - 0 \cdot 0169.\frac{\rho}{g}.A.V^2$$

where T_s = 1,925 lbs.
and k_{r_3} = 0·0169.

Note.—The values for T_s and k_{r_3} have to be obtained for each different power unit from graphs showing the relationship between thrust and forward speed of the machine.

4°. We next tabulate k_y and k_X, where
$k_X = (k_x + k_{r_1} + k_{r_2} + k_{r_3})$ as in Fig. 1.

5°. The polar curve of k_y to k_X is then drawn as is shown in Fig. 3.

6°. Maximum flight speed at sea-level is obtained by drawing the line $\theta = \frac{k_X}{k_y} = \frac{T_s}{W} = \frac{1,925}{5,960} = 0 \cdot 323.$

We must find the point where this line cuts the polar curve. We see that k_X is 0·0457.

$$\therefore \ V_{max} \text{ (knots)} = \frac{1}{1 \cdot 685}\sqrt{\frac{T_s}{\rho/g . A . k_X}}$$

$$= \frac{1}{1 \cdot 685}\sqrt{\frac{1,925}{0 \cdot 00237 . 720 . 0 \cdot 0457}}$$

$$= 93 \cdot 3 \text{ knots.}$$

7°. Maximum ceiling is given by the tangent to the polar curve from the origin ; here $\theta_{min} = \frac{k_X}{k_y} = 0 \cdot 193.$

$$\therefore \ \frac{\theta_{min}}{\theta} = \frac{0 \cdot 193}{0 \cdot 323} = 0 \cdot 598 = \frac{\rho'}{\rho}$$

This assumes that the engine power varies directly with the density of the air for altitudes. The error involved is not very great on account of the ratio of $\left(\frac{k_{r_3}}{k_X}\right)$. From curves showing the variation of the density of the atmosphere with altitude we find that $\frac{\rho'}{\rho} = 0 \cdot 598$ at an altitude of 14,750 ft. This is therefore the absolute ceiling of the machine. The ceiling could have been found, too, from the formula quoted previously.

8°. The rate of climb (in feet per minute) is given by
$V = 0 \cdot 00323\ \theta_{min}.V_c\ (14,750 - H_1)$
where V is in feet per *minute*
H_1 is the altitude at which the rate of climb is required

$$\text{and } \quad V_c = \sqrt{\frac{1,925}{0 \cdot 00237 . 720 . 0 \cdot 193}} = 76 \cdot 2 \text{ ft/sec.}$$

$\therefore$ V at 3,000 ft = 0.00323 × 0·193 × 76·2 × 11,750
= 557 ft./min.
Similarly, V at 6,000 ft. = 415 „
and V at 10,000 ft. = 226 „

Conclusions

In a limited amount of time I have endeavoured to set before you the outstanding features in the estimation of an aeroplane's performance (1) by the ordinary standard English method and (2) by the polar method. Both have their useful points, and both have their drawbacks.

There is not a great deal of variation in the results as obtained by either method from the actual results as obtained in the trials of the "Swift F." If anything, the climb to altitudes is represented more nearly by the modified German method results than by the English results.

The actual amount of work required in the estimation of performance is less by the modified German method than by the English method, thus making it more applicable for use in the drawing-office.

TABLE I.—"*Swift F*" *Performance*

Power available.

V Knots.	η	BHP.	$\frac{\text{Thrust}}{V} = 325 \cdot 5\ \text{HP.}$	$\frac{T}{A_e}$	v ml./hr.	V ft./sec.	$V + v_x$ ft./sec.	$(V + v_x)^2$ (ft./sec.)^2
108	0·730	343	1,033	12·46	124·3	182	209	47,000
99	0·747	351	1,154	13·90	113·0	167	198	41,500
90	0·756	355	1,286	15·50	103·5	152	192	36,860
72	0·677	318	1,443	17·40	83·0	121·2	174	30,280
54	0·556	261	1,575	19·00	62·2	91	161	25,920
36	0·412	193	1,735	20·90	41·4	60·7	153	23,450

Power at Altitudes

Sea-level.		3,000′.		6,000′.		10,000′.	
Corrn. Factors :		0·991	0·91	0·98	0·821	0·964	0·71
V.	HP.	V.	HP.	V.	HP.	V.	HP.
108	343	—	—	—	—	—	—
99	351	98	319	97	288	96	249
90	355	89	323	88	291	88	252
72	318	71	290	70	261	69	226
54	261	54	238	53	214	52	185
36	193	36	175	35	158	35	136

Propeller data : diameter = 11′ 6″ = 138″.

Designed speed = 90 knots.

BHP at 2,000 r.p.m. = 470.

Propeller r.p.m. = 0·659 × 2,000.

$$\text{Using Bolas's curves, } K = \frac{90}{0 \cdot 659 \times 200 \times 138} = 0 \cdot 000495.$$

A_e = 83 sq. ft.

TABLE II.—"*Swift F*" *Performance*

Body Resistance

$\frac{K_y}{K_{y\,max}}$	L/D Corrd.	V Knots.	V^2 (ft./sec.)^2	$(V + v_x)^2$ (ft./sec.)^2	Inside SS 169 lbs. at 100 f.s.	Outside SS 48 lbs. at 100 f.s.	M. Plane Resist.	Total Res. (lbs.)	BHP Reqd.
0·2	11·98	96·1	26,250	40,000	676	126	497	1,299	382
0·3	15·74	78·4	17,500	32,300	545	84	378	1,007	243
0·4	16·74	67·9	13,125	29,200	493	63	365	921	193
0·5	15·04	60·8	10,500	27,400	462	50	396	908	170
0·6	13·85	55·4	8,750	26,200	442	42	430	914	156
0·7	12·81	51·4	7,500	25,400	429	36	465	930	147
0·8	11·39	48·0	6,562	25,000	422	32	523	977	144
0·9	10·17	45·3	5,833	24,500	414	28	586	1,028	143
1·0	7·82	43·0	5,250	24,200	408	25	762	1,195	158

Power required at Altitudes.

Sea-level.		3,000′.		6,000′.		10,000′.	
Corrn. Factors :		1·06.		1·115.		1·192.	
V.	HP.	V.	HP.	V.	HP.	V.	HP.
96·1	382	102	404	107	425	115	455
78·4	243	83	258	88	271	94	290
67·9	193	72	204	76	215	81	230
60·8	170	65	180	68	190	73	203
55·4	156	59	165	62	173	66	185
51·4	147	55	156	57	164	62	175
48·0	144	51	153	54	160	57	172
45·3	143	48	152	51	159	54	171
43·0	158	46	167	48	176	51	189

◈ ◈ ◈ ◈

The Royal Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

ANNUAL GENERAL MEETING

THE Annual General Meeting of the Royal Aero Club was held at the Club premises, 3, Clifford Street, London, W., on Wednesday, March 28, 1923, at 4 p.m.

The Chairman, Lieut.-Col. J. T. C. Moore-Brabazon, M.P., referred to the loss the Club had sustained by the death of Lord Northcliffe, who had been a Vice-President and Member of the Committee for many years. The late Lord Northcliffe had assisted Aviation from the very beginning, and through the *Daily Mail* had given prizes for Aviation contests amounting to nearly £40,000.

He also referred to the death of Sir Ross Smith, in April last, just prior to his projected flight round the world.

The Flying Services Fund which was administered by the Club had distributed £1,575 in grants and allowances during the past year to dependents of officers and men of the Royal Air Force. The fund was providing school fees for twenty children and allowances to forty dependents.

During the year the Club had celebrated its twenty-first Anniversary with a banquet, which was largely attended by the members. Another banquet was held to commemorate the King's Cup Race and the British victory in the Schneider International Seaplane Race.

The Club was represented on the Civil Aviation Advisory Board by Brig.-Gen. Sir Capel Holden. The Club was also represented on the International Air Congress, 1923, by Colonel F. Lindsay Lloyd, Lieut.-Col. F. K. McClean, and Mr. H. E. Perrin.

The work of the Fédération Aéronautique Internationale, of which the Royal Aero Club was the representative for the British Empire, included the advancement of international sport and touring. The representatives of the Club, Lieut.-Col. M. O'Gorman and the Secretary, had attended conferences in Rome and Paris during the year, and under the auspices of the Fédération, it had hoped shortly to introduce the Customs Carnet for touring aircraft on similar lines to that in force for motor-cars.

The Chairman stated that the Club's main object was the encouragement of the sport of flying, and, during the year, several sporting events had been organised. The outlay involved in organising these meetings and putting up prizes amounted to over £7,000. He was pleased, however, to report that this expenditure had been practically met by the receipts from such meetings, and the cost to the Club had been under £50.

Through the efforts of Major-Gen. Sir W. S. Brancker, Chairman of the Racing Committee, they had been able for the first time to hold a race for a prize presented by His Majesty the King. The race round Great Britain had created enormous interest throughout the country, and resulted in a victory for Sir Samuel Instone, who entered a D.H.4A, piloted by F. L. Barnard. One of the features of the race was the participation of private owners.

He was pleased to announce that His Majesty the King had again consented to put up a cup for a similar race this year.

Schneider Cup.—The race for the International Schneider Cup was held at Naples last year. The representative of the Royal Aero Club was a Supermarine-Napier flying boat constructed by the Supermarine Aviation Works, Ltd., Southampton. It was a matter of great satisfaction both to the Club and the British Aircraft industry to record the victory of the Supermarine-Napier flying boat in this International race, and the utmost credit was due to the Supermarine Aviation Works for the construction of the machine and to D. Napier and Son for the engine. The pilot was Capt. H. C. Biard, and for a course of 200 sea miles he put up a world's record for seaplanes, having accomplished the course at a speed of 145.7 m.p.h.

The Aerial Derby, held on August Bank Holiday, resulted in a victory for the Gloucestershire Mars I, constructed by the Gloucestershire Aircraft Co., Ltd., with a Napier "Lion" engine. The pilot was J. H. James, who completed a distance of 200 miles at a speed of 176·48 m.p.h.

The Aerial Derby Handicap resulted in a victory of the Lucifer Monoplane, constructed by the Bristol Aeroplane Co., and piloted by L. L. Carter.

The Club was represented in two other international races, viz., the Gordon Bennett Balloon Race in Switzerland by Mr. E. Allen and Mr. Griffith Brewer, and the Deutsch Cup in France by the Gloucestershire Aircraft Co.

In addition to these races, the Club organised race meetings at Croydon at Easter and Whitsuntide, and the attendances on both occasions showed that the public took a keen interest in air racing.

The interest taken in gliding abroad suggested to the

Committee the advisability of holding a competition in this country, and thanks to the proprietors of the *Daily Mail* had been able to offer a prize of £1,000 to the competitor who made the longest flight with a minimum of half-an-hour. This competition, which was held at Itford Hill, created enormous interest throughout the country. There was, however, little time for British competitors to construct machines, and although practically none of the British competitors had previously had any experience of gliding, the performances they put up were, on the whole, far in advance of those accomplished abroad.

On the last day of the meeting a world's record was established by A. Maneyrol, who remained in the air for 3 hours 21 mins. 7 secs.

The most noteworthy performances put up by the British competitors were :—

F. P. Raynham	1 hour 53 mins. 2 secs.
Squadron-Leader Gray	1 hour 4 secs.
Olley	49 mins.

The Committee recognised the value of gliding, and it was hoped to hold a competition in the autumn this year.

In addition to the £1,000 prize kindly presented by the proprietors of the *Daily Mail*, he would like to mention that the whole of the costs of organising the competition amounting to £1,365 were also defrayed by the proprietors of the *Daily Mail*.

As the outcome of this competition, Mr. H. Gordon Selfridge had offered through the Club a prize of £1,000 to the first British competitor who accomplished a glide of 50 miles. If this was not attained during the year, Mr. Gordon Selfridge would present a consolation prize of £500 for a glide of 25 miles.

He referred to the facilities offered to members of the Club for flying in the Club aeroplanes at Croydon Aerodrome. He hoped that during the coming year these would be used more extensively.

The Club's F.A.I. Certificate was accepted by the Air Ministry as qualification for the "A" licence.

The Air Ministry also recognised the Club as the competent authority for holding the Technical Examination for "A" licences, as laid down by the International Air Convention. These examinations were conducted by the Club for applicants for "A" licences.

With the object of furthering the aims of the Club, and of obtaining wider public support for its activities, at the beginning of this year the Committee had instituted an Associateship, with an annual subscription of £1 1*s*.

It was thought that there were a large number of persons interested who did not wish to join the Club as full members, but who wanted to support aviation. The Associateship met this case, and they were able to offer a number of facilities, including free admission to the Club's race meetings, and passenger flights at half price with approved firms. He hoped that members would assist in making this known to their friends, as it was of the utmost importance that greater interest should be taken in aviation in this country.

The funds derived from Associateship would be used in promoting flying contests and offering prizes to encourage progress in design of aircraft and engines, and assist in the development of gliding.

He mentioned that the Club's membership had fallen off considerably during the last two years, and in view of the work which the Club was doing for the furtherance of aviation he considered it was most essential that more support should be given to the Club. He hoped, therefore, that present members would assist by inducing their friends to join the Club either as members or Associates.

In conclusion, he remarked that our Naval supremacy had been founded on the fact that we were a nation of sailors. We wanted to see our aerial supremacy founded on the fact that we were a nation of airmen.

On the motion of Rear-Admiral Sir Godfrey M. Paine, seconded by Lieut.-Col. M. O. Darby, Club Rule 73 was altered to read as follows :—

"The Committee may associate with or affiliate to the Club other aeronautical clubs or bodies or individuals, on such terms and subject to such agreements as the Committee may from time to time approve."

A vote of thanks to the Chairman, proposed by Gen. Sir Capel Holden, was carried unanimously.

The following members were elected to fill the nine vacancies on the Committee :—

Lieut.-Col. M. O. Darby.
Lieut.-Col. John D. Dunville.
Brig.-Gen. Sir Capel Holden, K.C.B., F.R.S.
Lieut.-Col. F. K. McClean, A.F.C.
Capt. D. G. Murray.
Lieut.-Col. Alec Ogilvie, C.B.E.
F. Handley Page.
Rear-Admiral Sir Godfrey M. Paine, K.C.B., M.V.O.
T. O. M. Sopwith.

Vice-President and Council

On the motion of the Chairman, seconded by Lieut.-Col. F. K. McClean, the following were unanimously elected :—

Vice-President : The Duke of Sutherland.

Council : S.A.I. Prince Roland Bonaparte, the Earl of Hardwicke, the Earl of Lonsdale, Admiral of the Fleet the Earl Beatty, G.C.B., O.M., G.C.V.O., D.S.O., the Right Hon. Lord Hugh Cecil, M.P., the Lord Howard de Walden, the Lord Montagu of Beaulieu, C.S.I., Admiral of the Fleet the Right Hon. Sir Edward Seymour, G.C.B , O.M., G.C.V.O., Admiral the Hon. Sir Edmund Fremantle, G.C.B., C.M.G., Air-Marshal Sir Hugh M. Trenchard, Bart., K.C.B., D.S.O., Sir David Salomons, Bart., Sir Basil Zaharoff, G.B.E., G.C.B., Count Henry de la Vaulx, the Rt. Rev. Bishop Welldon, Martin Dale and Andre Michelin.

Offices: THE ROYAL AERO CLUB,
3, CLIFFORD STREET, LONDON, W. 1.
H. E. PERRIN, Secretary.

LONDON TERMINAL AERODROME

Monday evening, April 2

THE Easter traffic has exceeded all expectations on the Paris route, but has fallen below what was confidently expected on the Cologne and Amsterdam lines, although there was quite a rush of passengers towards the end of the week to and from these two places.

On the London-Paris airway both the Handley Page Co. and the Air Union have been running with full loads, and have both been turning down last minute bookings. In fact, many people have arrived at the aerodrome in motor-cars and taxis, without having previously reserved seats on the 'planes, just on the off-chance of there being room.

Motor-Cycles by Air

THE first motor-cycle to be flown to the continent was carried in one of the Instone Air liners during the week. This was a Norton, weighing over 200 lbs., and was consigned to an agent in Cologne. This particular agent avers that it takes him no less than six weeks to get a motor-bicycle from London to Cologne by the ordinary train and boat methods, and he proposes, as a result of the first experiment of sending one by air, to send seven or eight in a batch once a fortnight. This will just be about a full load for a D.H.34, and I understand that the Instone line intend putting on a special machine once a fortnight to deal with this traffic.

Messrs. Muir and Youell are back from their flight to Spain, which country they reached in quick time. One aerodrome at which they landed was flooded, and Mr. Youell alighted in a pond, which it was impossible to distinguish from the remainder of the flooded aerodrome. He made a quick exit from his machine, under the impression that he was about to meet a watery end. The case was, however, hardly as bad as this, and the machine was quickly rescued, little if any the worse for its partial immersion.

Mr. Hinchcliffe, who has been indisposed for some weeks, and has in consequence been the subject of rumours as to his leaving the Daimler Airway, passed his medical examination triumphantly during the week, and is again flying the Daimler Company's red 34's. His first flight after his indisposition was to test a new engine which had been installed, and also to carry out tests with Verey lights and Holt flares. From the ground a Holt flare in full flame looks a dangerous object, but the flare is well away from the machine and there is no risk of fire.

Daimler Pilots Entertained by Colonel Searle.

COLONEL SEARLE, managing director of the Daimler Airway, entertained the pilots of the Daimler Airway to dinner on the evening of the 28th to celebrate the conclusion of one year's operations by that company. During that period their machines have flown a distance of no fewer than half a million miles, and one machine alone, the famous G.EBBS, has now completed close on 130,000 miles.

Joy-riding has, of course, been brisk over the holidays. The Surrey Flying Services have had two machines out, one of them the D.H.9, which Capt. Muir flew for the Duke of Sutherland in the Race Round Britain, and subsequently bought for the Surrey Flying Services.

The Surrey Flying Services are, I hear, to open joy-ride centres this summer at Portsmouth and Yarmouth ; while they are also in negotiation to a similar end in regard to a couple of other holiday resorts.

The Cone Light has been moved to a position about midway along the south side of the aerodrome.

THE ROYAL AIR FORCE

London Gazette, March 27, 1923.
General Duties Branch.

Flight Lieut. A. S. C. Maclaren, O.B.E., M.C., D.F.C., A.F.C., is granted a permanent commn. in rank stated; Sept. 9, 1920 (since promoted). *Gazette*, Sept. 14, 1920, appointing him to a short service commn. is cancelled. Flying Offr. G. L. Carter is granted permanent commn. in rank stated; Jan. 20, 1920. *Gazette* Jan. 20, 1920, appointing him to short service commn. is cancelled. Flying Offr. (hon. Flight Lieut.) C. M. E. Gifford is granted short service commn. as Flying Offr. for seven years on active list; Feb. 15. Lieut. L. W. Lane, M.C., Royal Sussex Regt., is granted a temp. commn. as Flying Offr. on seconding for four years' duty with R.A.F.; March 16.

The follg. are transferred to the Reserve:—

Class A.—Flying Offr. J. S. J. Craigen; March 26.

Class C.—Flying Offr. G. D. Ashby; March 30.

Flying Offr. W. F. McManus, relinquishes his short service commn. on account of ill-health, and is permitted to retain rank of Lieut.; March 28: the short service commn. of Pilot Offr. A. M. A. Forde is terminated on cessation of duty; March 13.

Reserve of Air Force Officers.

Observer Offr. D. H. Murray is tranferred from Class B to Class C; March 16.

Memoranda.

Lieut. E. J. Wilkins relinquishes his temp. commn. on ceasing to be employed, and is permitted to retain his rank; March 17. The permission granted to Sec. Lieut. (hon. Lieut.) C. J. R. Gibson to retain his rank is withdrawn on his joining the Territorial Army; May 31, 1920. The name of Sec. Lieut. A. V. Leckie is as now described, and not A. B. Lackie, as *Gazette*, May 9, 1919.

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the R.A.F. are notified:—

Wing Commanders: E. R. C. Nanson. The rank of this officer is as now stated, not Group Captain as stated in R.A.F. Bulletin No. 111, dated March 20. E. M. Murray, D.S.O., M.C., from No. 45 Squadron (Iraq Command) to command No. 2 Wing Headquarters (India). 2.3.23. J. C. Halahan, C.B.E., A.F.C., from Headquarters, R.A.F., India, to command No. 3 Wing Headquarters (India). 15.2.23. J. R. W. Smyth-Piggott, D.S.O., from R.A.F. Depot (Inland Area) to command Armament and Gunnery School (Inland Area). 23.2.23. O. T. Boyd, O.B.E., M.C., A.F.C., from No. 24 Squadron (Inland Area) to command School of Army Co-operation (Inland Area). 15.2.23. Substituted for the notification concerning this officer contained in R.A.F. Bulletin No. 111, dated March 20.

Squadron Leaders: C. C. Durston, from R.A.F. Depot (Inland Area) to School of Army Co-operation (Inland Area). 16.3.23. A. Burtenshaw, O.B.E. M.C., to command Central Supply Depot (Iraq Command). On appointment to short service commission in Stores Branch. H. F. Fuller, from Inland Area Aircraft Depot to Headquarters, R.A.F., Cranwell. 13.3.23. A. G. R. Garrod, M.C., D.F.C., from School of Army Co-operation (Inland Area) to R.A.F. Staff College (Inland Area). 3.4.23.

Flight Lieutenants: F. J. Murphy, M.C., from Engine Repair Depot (Middle East) to No. 4 Flying Training School (Middle East). For duty as Medical Officer. To remain attached to Stores Depot, Egypt. 16.2.23. V. R. Smith, from Headquarters, R.A.F. (Middle East) to Engine Repair Depot (Middle East). 12.2.23. W. A Harvey, from Boys' Wing (Cranwell) to Inland Area Aircraft Depot (Inland Area). 23.3.23. W. G. L. Wambeek, from No. 20 Squadron (India) to Aircraft Depot (India). 17.2.23. E. O. Grenfell, M.C., A.F.C., from No. 27 Squadron (India) to No. 1 Squadron (Iraq Command). For duty as Adjutant. 3.2.23. J. L. Vachell, M.C., from No. 27 Squadron (India) to No. 3 Wing Headquarters (India). For duty as Adjutant. 15.2.23. R. A. de H. Haig, from Aeroplane Experimental Establishment (Coastal Area) to command Experimental Section, R.A.F. (Inland Area). 23.4.23. E. C. Emmett, M.C., D.F.C., from No. 39 Squadron (Inland Area) to R.A.F. Depot (Inland Area). (Supernumerary.) 1.4.23. L. F. L. Bawn, from Inland Area Aircraft Depot (Inland Area) to Boys' Wing (Cranwell). 9.4.23. W. C. Clark, from R.A.F. Depot (Inland Area) to School of Technical Training (Men) (Inland Area). 19.3.23. E. Bennett, from No. 1 Stores Depot to No. 1 School of Technical Training (Boys) (Halton). 20.3.23. A. M. Moffatt, from Armament and Gunnery School (Inland Area) to Headquarters, Coastal Area. (Supernumerary.) 4.4.23. E. R. Whitehouse, from No. 1 School of Technical Training (Boys) (Halton) to No. 2 Flying Training School (Inland Area). 9.4.23. P. E. Maitland, A.F.C., from No. 4 Flying Training School (Middle East) to No. 45 Squadron (Iraq Command). 23.1.23. P. J. Barnett, M.C., from R.A.F. Depot (Inland Area) to No. 39 Squadron (Inland Area). For duty as Adjutant. 26.3.23. V. Aalbrecht, O.B.E., M.C., from No. 4 Flying Training School (Middle East) to Central Flying School (Inland Area). (Supernumerary.) 1.4.23. R. Whyte, from School of Technical Training (Men) (Inland Area) to No. 1 School of Technical Training (Boys) (Halton). 18.3.23. F. T. Allen, from No. 2 Flying Training School (Inland Area) to R.A.F. Depot. 12.4.23. R. H. Wace, M.B., from No. 1 School of Technical Training (Boys) (Halton) to Central Medical Board (Coastal Area). 6.4.23. H. E. H. Tracy, from Research Laboratory and Medical Officers' School of Instruction (Coastal Area) to No. 1 School of Technical Training (Boys) (Halton). 6.4.23.

Colonel Wilkinson Dent, C.B.E., D.S.O. (Indian Army), to Headquarters (Iraq Command). On attachment to Royal Air Force for two years. 1.10 22.

Captain (Brevet Major) C. M. Tippetts (South Wales Borderers) to Headquarters (Iraq Command). On attachment to Royal Air Force for two years. 9.2.23.

PERSONALS

Married

The marriage took place in Paris, on March 15, of MAGDA, daughter of the MARQUIS LOUIS DE CHASSELOUP-LAUBAT, the eminent engineer, and PRINCE ACHILLE MURAT, great-grandson of Napoleon's brother-in-law and King of Naples. Prince Achille served during the War at the age of 18 in the trenches, and received the Croix de Guerre from General Gouraud for services in the Flying Corps in Syria.

Capt. WILLIAM STUART PHILCOX, D.F.C., B.A., only son of Mr. and Mrs. C. W. Philcox, of 2, Lancaster Road, West Norwood, was married on March 24, at St. Luke's, West Norwood, to NORA ANGELA ROSE, second daughter of Mr. and Mrs. HERBERT INGRAM, of 12, Lancaster Road, West Norwood.

To be Married

The marriage arranged between Flight Lieutenant J. O. ANDREWS, D.S.O., M.C., only son of the late John Andrews and Mrs. Hartmann, of Sudbury, Middlesex, and BERTHA WINIFRED, eldest daughter of Mr. and Mrs. WILFRED BISDEE, of Hambrook, Glos., will take place quietly at Frenchay Church on April 14.

The engagement is announced between Capt. W. T. F. HOLLAND, A.F.C., late 21st Lancers and R.A.F., only son of the late Mr. and Mrs. Walter Holland, late of Compton Hill, Farnham, and Wood Hall, Worcester, to MAREE, widow of Brig.-General C. T. MARTIN, D.S.O., H.L.I., and only daughter of Mr. and Mrs. ANDREW STRANG, Limekilns, East Kilbride, Lanarkshire.

A marriage has been arranged, and will shortly take place, between Commander KENNETH MACKENZIE-GRIEVE, A.F.C., R.N., youngest son of Captain and Mrs. Mackenzie-Grieve, of Droxford, Hants, and JANET, youngest daughter of Mr. and Mrs. CLINTON BADDELEY, of Dibden, Hants.

Killed

Pilot Officer R. C. BROOKE-HUNT, R.A.F., who was killed in a flying accident on March 26, at Shotwick, was the elder son of Lieut.-Col. R. H. Brooke-Hunt, of Hundleby House, Spilsby.

Death

It is with regret that we have to announce the death of Lady Llangattock, which took place at South Lodge, Rutland Gate, S.W., on April 1. Lady Llangattock was the youngest daughter of Sir Charles Fitzroy Maclean, and was the mother of the Hon. C. S. Rolls, who was killed at the Bournemouth Aviation Meeting in 1910.

Items

The marriage arranged between Miss SYBIL LATTA and Flight-Lieut. JOHN BERESFORD COLE-HAMILTON, R.A.F., will not take place.

We are pleased to note that the Receiving Order for bankruptcy against Patrick Y. Alexander has been rescinded, debts having been paid in full.

THE INDEFATIGABLE G-EBBS: This D.H.34 has now flown more than 110,000 miles, and has never had to make a landing outside a licensed aerodrome, which speaks well for the reliability of the Napier "Lion" engine with which it is fitted.

IN PARLIAMENT

Co-ordination of Fighting Services

MR. LAMBERT on March 26 asked the Prime Minister the names of the members of the Committee appointed to co-ordinate the activities of the fighting Services; when that Committee will sit; and when it may be expected to report?

The Prime Minister: It is not customary to give the names of members of sub-Committees of the Committee of Imperial Defence. I am glad to say, however, that Lord Balfour and Lord Weir have consented to join the Committee. With regard to the second part of the question, the Committee has already held several meetings, but it is not yet possible to say when it will be able to report.

Mr. Lambert: Is not the Committee of Imperial Defence composed of the same gentlemen who have led us into this disastrous mess?

The Prime Minister: Oh, no. They are quite different.

British and French Armies and Air Forces

MR. T. THOMSON asked the Under-Secretary of State for War the cost in francs and the size of the French Army and Air Force in 1913-14 and at the present time, and the corresponding figures for the British Army and Air Forces?

Lieut.-Col. Guinness: The French Army, including Air Force, in 1914 cost 1,923,476,000 francs and had a Budget strength of 917,000 men. The corresponding figures for 1923 are 4,191,060,324 francs and 732,248 men. This does not include the Colonial Army stationed in the Colonies which amounted to 64,700 in 1914 and 52,000 in 1923. The French figures include no pensions. The British Army in 1913-14 cost £27,700,000 and had an establishment of 182,300 exclusive of the Territorial Army. The corresponding figures for 1923 are £52,550,000 and 160,300. The British figures include service pensions, but nothing for aviation.

Air Mails

MR. BURGESS asked the Postmaster-General the number of Continental cities which are directly connected with London by air post; and to what extent does he propose to extend this service?

Sir W. Joynson-Hicks: Mails are sent to and received from the Continent by three air routes: (1) London-Paris, (2) London-Brussels-Cologne, (3) London-Amsterdam-Rotterdam. If and when any of these routes is extended, arrangements will be made for through air mails from London to the more distant termini.

Hague Bombing Declaration

MR. LEACH, on March 28, asked the Under-Secretary of State for War why the Regulation made at the Hague Conference of 1899, on the proposition of Great Britain, prohibiting the use of projectiles and explosives from aircraft is not now acted upon by Great Britain, at least in cases where the enemy does not employ aircraft?

Sir S. Hoare: I have been asked to reply. The Hague Declaration of 1907, which replaced the expired Declaration of 1899, prohibits the discharge of projectiles and explosives from balloons or by other new methods of a similar nature, but it applies only to wars in which parties to the Declaration are alone engaged; and very few Powers have in fact ratified it. The fact that a State does not itself employ aircraft in no way affects the right to use against it projectiles and explosives dropped from aircraft.

Navy, Army and Air Force Technical Services

LIEUT.-COLONEL FREMANTLE, on March 29, asked the Under-Secretary of State for War if His Majesty's Government has considered the Report of the Committee dealing with the co-ordination of the technical services of the Navy, Army and Air Force; if so, will he state what action, if any, is proposed as a result; and what opportunity will be given for such proposals to be considered and discussed by the House?

Mr. Gwynne: The answer to the first part of the question is in the affirmative, and steps are being taken, particularly by the establishment of inter-departmental technical committees, to carry out the necessary detailed measures of co-ordination. With regard to the last part of the question, I would refer the hon. and gallant member to the reply which my hon. friend gave him on March 22, to the effect that it was not proposed to publish the Report of the Committee.

Lieut.-Colonel Fremantle: Are we to understand that this most vital decision with regard to some technical questions is being already acted upon without any report being made to this House, or any opportunity being given for its discussion?

Mr. Gwynne: Yes, Sir; it is a matter for the Cabinet.

Captain Wedgwood Benn: Can the hon. gentleman say why it was considered inadvisable to publish the particulars?

Mr. Gwynne: Because it is not usual in cases of this kind, and there is no intention of departing from what is usual.

※ ※ ※

New French World's Records

ON March 30 two French military aviators, Lieuts. Batelier and Garrier, established new world's records for speed over 500 kms. and 1,000 kms. respectively. Batelier covered the 500 kms. in 2 hrs. 42 mins. 51·6 secs., while Garrier took 6 hrs 39 mins. 40·4 secs. for the 1,000 kms. No information is available concerning the machines used.

Americans Beat French

THE two records established by Batelier and Garrier were not allowed to stand for more than a day. On March 31 two American military pilots, Lieuts. Peirson and Harris, beat both records, Peirson's time for the 500 kms. being 1 hr. 51 mins. 12 secs., while Harris covered the 1,000 kms. in 4 hrs. 52 mins. 32 secs.

Sadi Beaten?

FROM Dayton, Ohio, it is reported that on March 29 the world's speed record held by Saidi Lecointe with 375 kms./hr. was beaten by Lieut. Lester Maitland, whose average speed over the kilometre course was 243 m.p.h. (392 kms./hr.) The actual speed homologated may be somewhat lower. The Americans will probably turn their attention to world's speed records over the new 3-kilometre course next.

English Light Aeroplane Ready for Tests

THE light aeroplane designed by Mr. W. O. Manning for the English Electric Company of Preston, Lancashire, is now stated to be ready for its first flying tests, which will be made as soon as weather conditions are favourable.

SIDE-WINDS

THE extent to which civil aviation has developed since 1919 is seen by the fact that, from an investigation of the records kept of the running of engines, the "Rolls-Royce" aero engines have completed 1,123,243 (one million one hundred and twenty-three thousand two hundred and forty-three) miles in the air, exclusively in civil aviation up to the end of 1922. That stupendous mileage is subject to a substantial addition for the first three months of the current year, the precise figures for which are not yet available.

- - -

BARIMAR, LTD., advise that they have left Poland Street for good, and that the new address of their Head Office and London works is now 14-18, Lamb's Conduit Street, London, W.C. 1, to which address all letters and broken parts for attention in London, should, in future, be sent.

※ ※ ※ ※

NEW COMPANY REGISTERED

BRITISH MARINE AIR NAVIGATION CO., Woolston, Southampton.—Registered as a private company with a nominal capital of £15,000, in £1 shares. Under agreement with the Supermarine Aviation Works, Ltd., the Asiatic Petroleum Co., Ltd., etc.

※ ※ ※ ※

PUBLICATIONS RECEIVED

Aviation in New Zealand. By Henry F. Wigram. Canterbury (N.Z.) Aviation Co., Ltd., Aerodrome, Sockburn, Christchurch, New Zealand.

Conquest, April, 1923. The Wireless Press, Ltd., 12·13, Henrietta Street, London, W.C. 2. Price 1*s.* net.

Aeronautical Research Committee, Reports and Memoranda: No. 124, Downwash of Airplane Wings. By M. Munk and G. Cario. January, 1923. No. 125, Results of Experimental Flights at High Altitudes with Daimler, Benz and Maybach Engines. By K. Kutzbach. January, 1923. No. 126, Absolute Dimensions of Karman Vortex Motion. By W. Heisenberg. January, 1923. No. 127, The Air Propeller, Its Strength and Correct Shape. By H. Dietsius. February, 1923. No. 128, Tests on an Airplane Model, A.E.G. D.I., at Göttingen. By M. Munk and W. Molthan. February, 1923. National Advisory Committee for Aeronautics, Washington, D.C., U.S.A.

※ ※ ※ ※

AERONAUTICAL PATENT SPECIFICATIONS

Abbreviations: cyl. = cylinder; I.C. = internal combustion; m. = motor
The numbers in brackets are those under which the Specifications will be printed and abridged, etc.

APPLIED FOR IN 1921
Published April 5, 1923

32,522. RAOUL, MARQUIS OF PATERAS PESCARA. Aircraft. (172,331.)
33,211. W. WALMSLEY and M. FRANCIS. Rotary I.C. engine. (194,400.)

APPLIED FOR IN 1922
Published April 5, 1923

4,567. H. O. SHORT. Construction of wings, etc. (194,516.)
23,281. H. O. SHORT. Arrangement and construction of I.C. engines for aircraft. (194,630.)

FLIGHT

The Aircraft Engineer and Airships

36, GREAT QUEEN STREET, KINGSWAY, W.C. 2.
Telegraphic address: Truditur, Westcent, London.
Telephone: Gerrard 1828.

SUBSCRIPTION RATES

"FLIGHT" *will be forwarded, post free, at the following rates:—*

UNITED KINGDOM	s.	d.	ABROAD*	s.	d.
3 Months, Post Free...	7	7	3 Months, Post Free...	8	3
6 " " ...	15	2	6 " " ...	16	6
12 " " ...	30	4	12 " " ...	33	0

These rates are subject to any alteration found necessary under abnormal conditions and to increases in postage rates.

* *European subscriptions must be remitted in British currency*

Cheques and Post Office Orders should be made payable to the Proprietors of "FLIGHT," 36, Great Queen Street, Kingsway, W.C. 2, *and crossed London County and Westminster Bank, otherwise no responsibility will be accepted*

Should any difficulty be experienced in procuring "FLIGHT" *from local newsvendors, intending readers can obtain each issue direct from the Publishing Office, by forwarding remittance as above.*